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Forest Insect and Disease Management

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BIOLOGICAL
EVALUATION R2-78-7

WESTERN SPRUCE BUDWORM

Estes Valley

Colorado

August 1978

Rocky Mountain Region

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INTRODUCTION

In recent years, private landowners in the Estes Valley have been increasingly concerned with damage caused by outbreaks of the mountain pine beetle and western spruce budworm to their lands and surrounding Federal and State lands. This concern resulted in a well-conceived and executed program of mountain pine beetle suppression and more recently, considerable interest in the fate of Douglas-fir stands infested with western spruce budworm. Knowing private landowner concern and at the request of the Arapaho and Roosevelt National Forests and the Colorado State Forest Service, Jim Linnane, entomologist with the USDA Forest Service, and Dave Leatherman, entomologist with the Colorado State Forest Service, conducted a western spruce budworm egg mass survey in Estes Valley during August, 1978. The purpose of the survey was to ascertain the budworm population trend and to predict expected defoliation levels in 1979. In conjunction with budworm egg mass surveys, the Forest Insect and Disease Management Unit of the USDA Forest Service has undertaken a long term project to assess damage to Front Range forests caused by the western spruce budworm. The results of this project will be applicable to Douglas-fir stands within Estes Valley.

BIOLOGY OF THE WESTERN SPRUCE BUDWORM

The western spruce budworm, *Choristoneura occidentalis*, Freeman, is a principal defoliator in spruce-fir forest types in the West. In Colorado, the budworm's preferred hosts are Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, and white fir, *Abies concolor* (Gord. and Glend.) Linbl.. Subalpine fir, *A. lasiocarpa* (Hook.) Nutt., Engelmann spruce, *Picea engelmannii* Parry, and blue spruce, *P. pungens* Engelm., are also attacked.

The western spruce budworm has one generation per year in Colorado. Adult moths emerge and mate in July. Females may lay a partial compliment of their eggs shortly after mating, the remainder are deposited after a migration period. Eggs are found in masses cemented to the undersides of host tree needles and hatch in approximately ten days. The newly hatched larvae do not feed, but seek hiding places under bark scales on branches, in twig crotches, or among lichens where they spin silken shelters (hibernacula) and overwinter.

In the spring, larvae disperse to the foliage where they mine needles for one to two weeks. About the time buds begin to expand, larvae move into the buds and later, as the new shoots unfurl, spin loose

feeding webs between shoots. Larvae prefer to feed on new foliage and become full grown in 30 to 40 days after feeding begins in the spring. Pupation takes place in feeding webs or on the foliage. Adult moths are not strong flyers, but may be carried considerable distances by air currents.

BIOLOGICAL ASSESSMENT

Extent of the Outbreak. The western spruce budworm is the most serious defoliator in Douglas-fir stands in Colorado. Since 1974, the budworm has caused extensive and occasionally severe injury to Douglas-fir and true fir stands in Colorado. In 1978, the western spruce budworm caused visible defoliation on over 900,000 acres of Front Range forests (Figure 1). In the Estes Valley, budworm damage is evident most anywhere Douglas-fir is found.

Host Stand Condition. The ponderosa pine - Douglas-fir forest type predominates in Estes Valley below 9,000 feet in elevation. The Douglas-fir component of this type has been moderately to severely defoliated by the western spruce budworm since 1974. Budworm infestations may cause varied amounts of tree deformity, seedling damage, seed destruction, and poor stand regeneration. Stands which have been subject to several consecutive years of severe defoliation may incur top-killing and a still unknown amount of tree mortality. In the Estes Valley, top-killing in all size classes and tree mortality in the less than 5 inch d.b.h. size class is evident in severely infested stands.

Egg Mass Survey Methods. Forecasts of budworm defoliation are based on densities of new egg masses as determined by sampling small numbers of Douglas-fir. The sampling procedures used in this evaluation follow a sequential sampling scheme developed by McKnight.[1] Two 24-inch foliated branches are pruned from the mid-crown of each randomly selected sample tree (dominant and co-dominant crown classes). These samples are bagged, numbered, and transported to a lab for examination. Egg masses are separated under a microscope into new and old categories. Numbers of new egg masses are summarized and the next year's defoliation predictions are made following McKnight's scheme.

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[1] McKnight, M. E. et. al. 1970. Sequential plan for western spruce budworm egg mass surveys in the central and southern Rocky Mountains. USDA Forest Service, Research Note RM-174, 8 pp.

Sampling Results. Fourteen locations in and around Estes Valley were sampled in August of 1978. Figure 2 illustrates the general location of these sampling areas. Sampling results and defoliation predictions are presented in Table 1. Egg mass densities are expressed as egg masses per 1,000 sq. inches of foliage for easier comparisons. Injury classes referred to in Table 1 are based on the amount of defoliation observed on the new growth of Douglas-fir only.

Douglas-fir on Federal lands (sample locations 4 through 14 on Figure 2) in Estes Valley suffered moderate defoliation to new growth in 1978. Sampling results indicate light defoliation is expected in 1979. Egg mass sampling in the vicinity of Dry Gulch revealed the highest concentration of budworm of any sample location. Defoliation in the Dry Gulch area was heavy in 1978. Predicted defoliation in 1979 is moderate. Sampling in the vicinity of Hermit Park predicts undetectable defoliation in 1979. The Eoff property should experience light defoliation in 1979.

In total, 298 branches from 14 locations in and around Estes Valley were examined for budworm egg masses. The average egg mass density was determined as 10.6 egg masses per 1,000 sq. inches of foliage or class 3 (light in "static" infestations, moderate in "increasing" infestation) in McKnight's sample scheme. Based on this result, light defoliation (5 to 35% of new growth) is predicted in Estes Valley during 1979. However, in stands where defoliation has been severe and tree growth poor in recent years, budworm populations may be sufficient to inflict greater than light defoliation.

The western spruce budworm population trend in the Estes Valley appears to be static. Egg mass sampling results for Estes Valley and the Roosevelt National Forest for 1978 (10.6/1,000 sq. inches and 11.4/1,000 sq. inches respectively) when compared with 1977 sampling results for the Roosevelt National Forest (7.3/1,000 sq. inches) indicate a slight, but probably not a significant increase.

RECOMMENDATIONS

Presently, resource managers or landowners have basically two alternatives in dealing with budworm infested lands. Where objectives warrant, the first alternative is direct chemical control. The second is to take no action. Silvicultural management of susceptible stands, often

indicated as an important tool in reducing losses to forest insect pests, has not been adequately investigated in the central and southern Rocky Mountains for practical application.

Direct chemical control of budworm infestations through aerial applications of insecticide currently cost approximately $6.75 per acre for large operations and higher for small operations. Any insecticidal control project involving the western spruce budworm may require annual insecticidal applications to achieve tree protection throughout the duration of the infestation. Government conceived or funded proposals to implement direct chemical control on budworm infestations must be supported by biological evaluations, benefit-cost analyses, and environmental analyses. Presently, aerial applications of insecticide over the entire Estes Valley is not feasible and is not recommended. However, protection from budworm defoliation may be desirable and feasible in high value or high use areas, such as campgrounds, picnic grounds, recreation areas, areas with scenic values, Christmas tree production areas, or areas where landowners object to defoliation. These areas could be aerially treated or individual trees treated with ground applied insecticide. The final decision to implement budworm control projects rests with the landowner. Local land management agencies may be of assistance in the decision-making process.

The insecticides Sevin-4-Oil®, Orthene® and malathion are registered with the EPA for aerial application against the spruce budworm, Sevin-4-Oil® and Kryocide® are registered as ground applied insecticides. Where the use of chemical insecticides is undesirable, formulations of the microbial insecticide *Bacillus thuringiensis* (Thuricide®, Dipel®, etc.) are registered for budworm control.

The overall 1979 defoliation prediction for Estes Valley is light. However, some areas within the valley may experience more severe defoliation. A no action approach to a budworm infestation in these areas may result in varied amounts of tree deformity, seedling damage, seed destruction, and poor regeneration. Severe and consistent defoliation throughout the duration of an infestation will cause some top-killing and tree mortality. However, the greatest impact of budworm defoliation may be in high use and high value areas, where losses in recreational and aesthetic values may be a direct result of a budworm infestation.

PESTICIDE USE STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key -- out of the reach of children and animals -- and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

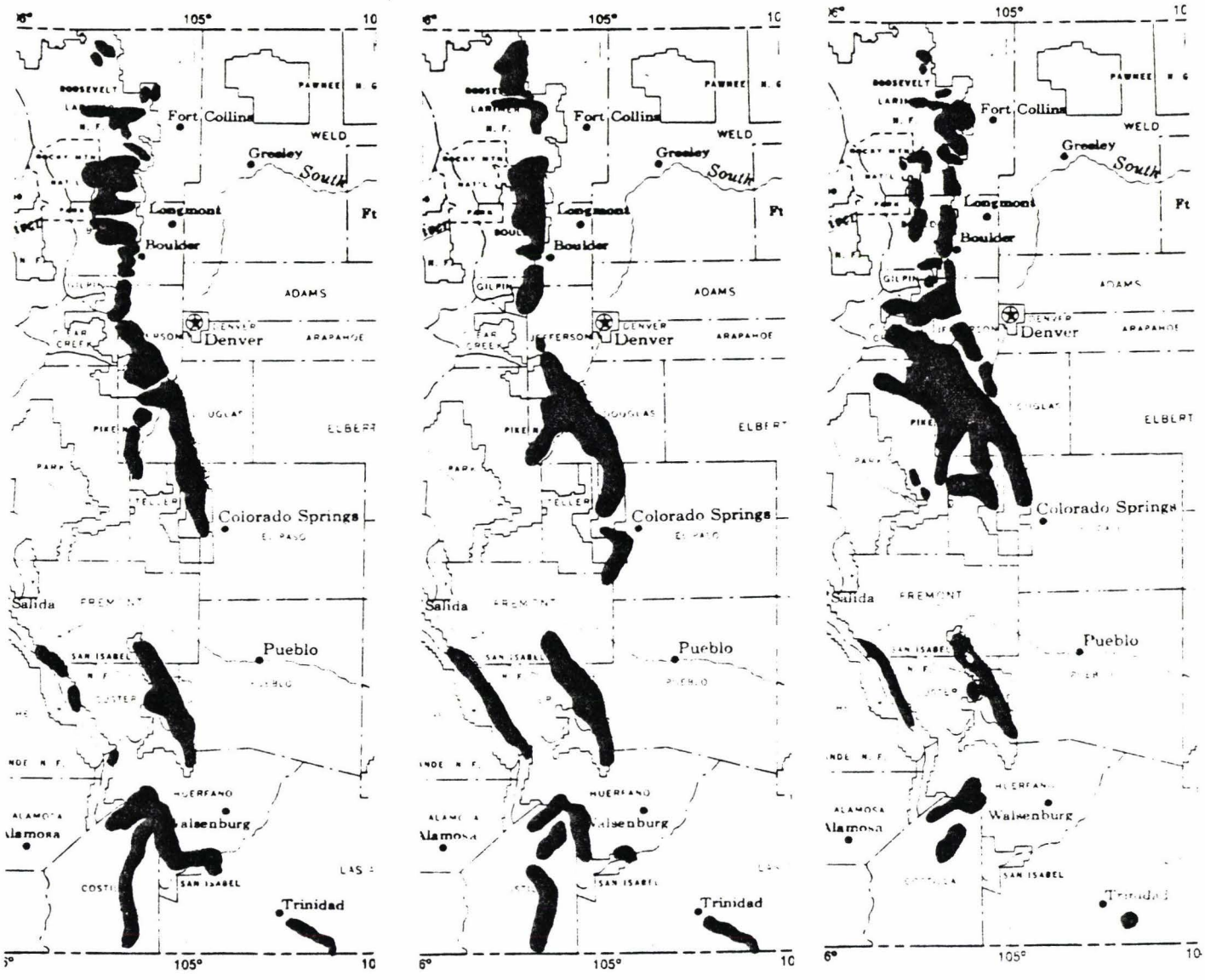
Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U. S. Department of Agriculture, consult your county agricultural agent or State Extension specialist to be sure the intended use is still registered.



1976
Aerial Detection
Budworm
Survey

719,360 A

1977
Aerial Detection
Budworm
Survey

915,840 A

1978
Aerial Detection
Budworm
Survey

967,840 A

Figure 1. Budworm aerial detection survey for 1976-1978.

FIGURE 2. Western Spruce Budworm Egg Mass Sampling Locations During 1978

Sample Locations ●

1 Dry Gulch
2 Hermit Park
3 Eoff Property
4 Devil's Gulch
5 Common Point
6 Glen Comfort
7 Pole Hill Rd.
8 Fingers
9 Mary's Lake
10 Lily Mtn.
11 Steep Mtn.
12 Glacier Basin
13 Eagle Cliff
14 Dunraven

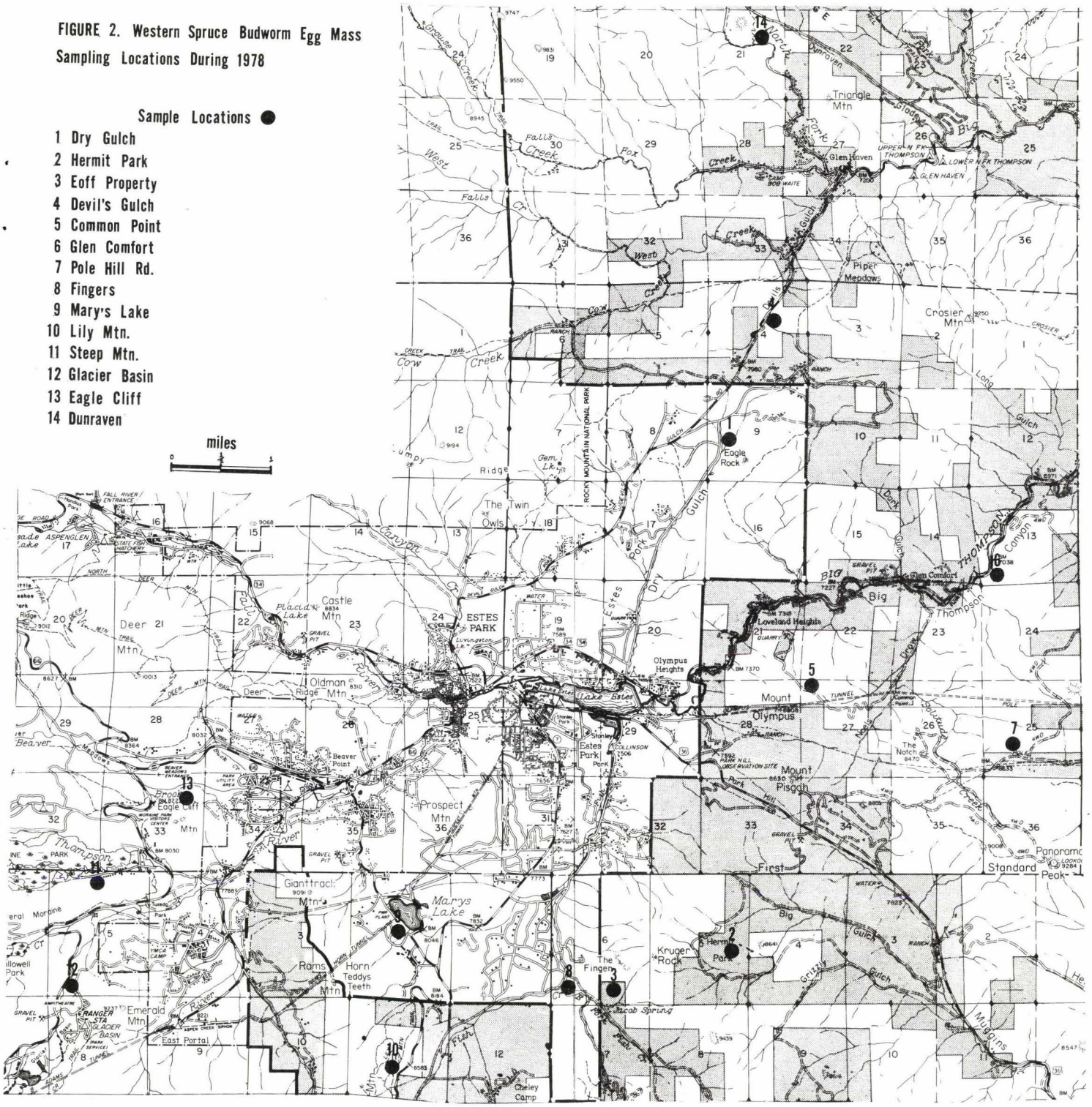


Table 1. Results of a Western Spruce Budworm Egg Mass Survey in Estes Valley

Location	Number Samples	No. New Egg Masses	Egg Masses/ 1,000^2 in foliage	1978 Defoliation Class [1/]	Sequential Sampling Class [2/]	1979 Defoliation Prediction [2/]
Federal Lands [3/]	148	163	8.0	moderate	3	light (static)
Dry Gulch	50	225	23.9	heavy	4	moderate
Hermit Park	50	18	2.1	light	2	undetectable (static)
Eoff Property	50	89	8.5	light	3	light (static)
Total	298	495	10.6	moderate	3	light (static)

[1/] Defoliation Classes for Current Growth

Class	% Defoliation
undetectable	0 to 5
light	5 to 35
moderate	35 to 65
heavy	65 and over

[2/] Class Limits for Sequential Sampling Plan [2] (from McKnight, et. al. 1970)

Class	New Egg Masses per 1,000 ^{2} in foliage	Defoliation Prediction
1	1.0 or fewer	undetectable
2	1.1 to 4.0	undetectable in "static" infestations, light in "increasing" infestations
3	6.0 to 20.0	light in "static" infestations, moderate in "increasing" infestations
4	22.0 or more	moderate or heavy

[3/] Sampling locations 4 through 14 on Figure 2.